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To: United States Patent & Trademark Office
Board of Patent Appeals and Interferences
(Attn: Cheryl Moore)
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Re: United States Patent Application No.: 09/754,486
Filing Date: January 3, 2001
Applicant(s): TEMPLE, ET AL.
Title: METHOD AND APPARATUS FOR FORMING NOZZLES

The Applicants respectfully submit herewith a Claims Appendix (including a clean copy of the claims involved in the appeal, as they presently stand), an Evidence Appendix (including the October 14, 2004 AFFIDAVIT OF STEPHEN TEMPLE UNDER 37 C.F.R. §1.132), and a Related Proceedings Appendix (indicating there have been no related proceedings). It is respectfully requested that these appendices be considered in conjunction with the Applicants' APPEAL BRIEF and the APPLICANTS' BRIEF IN REPLY TO THE EXAMINER'S ANSWER.

Date: March 2, 2006

Respectfully submitted,

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Certificate of Submission by Facsimile

I hereby certify that this correspondence is being submitted via facsimile on this 2nd day of March, 2006 to the United States Patent & Trademark Office, Board of Patent Appeals and Interferences, (571) 273-0300.

Jeremy R. Kriegel, Reg. No. 39,257

CLAIMS APPENDIX

This Claims Appendix reflects the claims as they presently stand in the application on appeal, including claim amendments made by way of the Amendment After Final mailed June 9, 2005, which the Examiner indicated in the Examiner's Answer has been entered and considered.

1-8. (Canceled)

9. Method of forming a nozzle in a nozzle plate for an ink jet printhead, the nozzle having a nozzle inlet and a nozzle outlet in respective opposite faces of said nozzle plate, the method comprising the steps of:

directing a high energy beam having a first axis extending in a first direction towards said nozzle plate; introducing divergence into said beam; thereafter directing said beam at a single aperture of a mask, thereby to shape said beam; thereafter passing said beam through beam converging means, and subsequently directing said beam at said substrate such that said beam first impinges upon the face of said nozzle plate in which said nozzle outlet is formed, thereby to form a nozzle, the nozzle outlet being conjugate through said beam converging means with said single aperture;

wherein the step of introducing divergence into said beam comprises splitting said beam into a number of sub-beams, each sub-beam having divergence, the origin of divergence of each sub-beam lying apart from the point at which the respective sub-beam is created by splitting; thereafter passing the sub-beams through further beam converging means prior to recombining and directing the sub-beams through said single aperture of said mask, wherein dimensions of a section of said recombined beam directly prior to impinging a plane of said mask are substantially equal to dimensions of said single aperture of said mask; and,

wherein said high energy beam is directed at a first planar reflecting surface lying at an angle to said first direction, said first surface being arranged so as to reflect said beam toward at least two additional beam reflecting surfaces so arranged as to both invert said beam and direct said beam along an axis colinear with said first axis extending in said first direction; said first planar reflecting surface and said at least two additional beam reflecting surfaces being fixed

relative to one another, thereby to form an assembly, and rotating said assembly about said first axis, said beam thereafter impinging on said nozzle plate, thereby to form said nozzle wherein said nozzle inlet is larger in diameter than said nozzle outlet.

10-22. (Canceled)

23. Method of forming a nozzle in a nozzle plate for an ink jet printhead, the nozzle having a nozzle inlet and a nozzle outlet in respective opposite faces of said nozzle plate, the method comprising the steps of:

directing a high energy beam having a first axis extending in a first direction towards said nozzle plate; directing said beam at a first reflecting surface lying at an angle to said first direction, said surface being arranged so as to reflect said beam towards a second reflecting surface and a third reflecting surface so arranged as to both invert said beam and direct said beam along an axis colinear with said first axis; said first, second, and third surfaces being fixedly located relative to one another, thereby to form an assembly, and rotating said assembly about said first axis; said beam thereafter being directed at and first impinging on a face of said nozzle plate in which said nozzle outlet is formed, thereby to form a said nozzle wherein said nozzle inlet is larger in diameter than said nozzle outlet.

24. Method according to claim 23 wherein the reflecting surfaces each comprises a discrete member.

25. Method according to claim 24, wherein said discrete member is a high reflectance dielectric mirror.

26-30. (Canceled)

31. A system for forming a nozzle in a nozzle plate for an ink jet printhead, said system comprising a nozzle plate substrate, and assembly, and a source of a high energy beam having a first axis extending in a first direction; wherein the assembly comprises a first reflecting surface lying at an angle to said first direction, a second reflecting surface, and a third reflecting surface, said first, second, and third reflecting surfaces being fixedly located relative to one another such that said high energy beam is reflected by said first reflecting surface towards said second reflecting surface and said third reflecting surface, thereby to both invert said beam and direct said beam along a second axis colinear with said first axis; said assembly being rotatable about said first axis, and said nozzle plate substrate being partly disposed within a path defined by said second axis and arranged such that said beam is directed at and first impinges upon a face of said nozzle plate substrate in which a nozzle outlet is formed, and wherein said nozzle outlet is smaller in size than a nozzle inlet formed in an opposite face of said nozzle plate substrate.

32-33. (Canceled)

34. Method according to claim 9, wherein the power of said high energy beam is initially held low and is increased with increasing depth of the nozzle formed in said nozzle plate.

35. Method according to claim 9, wherein a further mask is interposed between the mask and the beam converging means.

36. Method of forming a nozzle in a nozzle plate for an ink jet printhead, the nozzle having a nozzle inlet and a nozzle outlet in respective opposite faces of said nozzle plate, the method comprising the steps of:

directing a high energy beam having a first axis extending in a first direction towards said nozzle plate; introducing divergence into said beam; thereafter directing said beam at a single aperture of a mask, thereby to shape said beam; thereafter passing said beam through beam converging means, and subsequently directing said beam at said substrate such that said beam

first impinges upon the face of said nozzle plate in which said nozzle outlet is formed, thereby to form a nozzle, the nozzle outlet being conjugate through said beam converging means with said single aperture;

wherein the step of introducing divergence into said beam comprises splitting said beam into a number of sub-beams, each sub-beam having divergence, the origin of divergence of each sub-beam lying apart from the point at which the respective sub-beam is created by splitting; thereafter passing the sub-beams through further beam converging means prior to recombining and directing the sub-beams through said single aperture of a said mask, wherein dimensions of a section of said recombined beam directly prior to impinging a plane of said mask are substantially equal to dimensions of said single aperture of said mask;

wherein said high energy beam is directed at a first planar reflecting surface lying at an angle to said first direction, said first surface being arranged so as to reflect said beam toward a second beam reflecting surface and a third beam reflecting surface so arranged as to both invert said beam and direct said beam along an axis colinear with said first axis extending in said first direction; said first planar reflecting surface and said second and third beam reflecting surfaces being fixed relative to one another, thereby to form an assembly, and rotating said assembly about said first axis, said beam thereafter impinging on said nozzle plate, thereby to form said nozzle wherein said nozzle inlet is larger in diameter than said nozzle outlet; and,

wherein the power of said high energy beam is initially held low and is increased with increasing depth of the nozzle formed in said nozzle plate.

37. Method according to claim 36, wherein a further mask is interposed between the mask and the beam converging means.

EVIDENCE APPENDIX

- AFFIDAVIT OF STEPHEN TEMPLE UNDER 37 C.F.R. §1.132

Attorney Docket No: 27754/X254A

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICANT: Stephen Temple et al.	)	
APPLICATION NO.: 09/754,486	)	Examiner: Stefan Staicovici
FILED: January 3, 2001	)	Art Unit: 1732
FOR: Method of and Apparatus for Forming Nozzles	)	

AFFIDAVIT OF STEPHEN TEMPLE UNDER 37 C.F.R. §1.132

I, Stephen Temple, hereby swear as follows:

1. I am one of two joint inventors of the subject matter described and claimed in United States Patent Application Serial No. 09/754,486, (the application) entitled "Method of and Apparatus for Forming Nozzles."

2. I am Technical Director of Xaar plc and one of the founders of the company. I have a degree in Engineering Sciences from Oxford University and am a Fellow of the Royal Society of Arts and Manufacturing in the United Kingdom. I am an inventor of the original inkjet technology on which Xaar was founded, and have invented inkjet technologies covered by more than 90 patents and pending applications.

3. I have reviewed the most recent office action having a date of 15 June 2004 in the application. I have also studied each of the patents used to reject the claims of the application. In this affidavit, I discuss US 5 263 250 (Nishiwaki), US 5 569 238 (Shei) and GB 2 262 253 A (Turner).

4. The examiner has suggested in one rejection of the claims that it would have been obvious to one having ordinary skill in the art at the time of my invention to combine the teachings of Nishiwaki and Shei.

5. In my opinion, such a combination of documents would not have been obvious to the engineer working in the field of inkjet to which my invention specifically relates. Shei relates to an energy delivery system for use in laser eye surgery, a field completely unrelated to inkjet.

6. The inkjet engineer would have no motive to consider teachings in the laser eye surgery field, particularly given that inkjet technology involves the formation of a hole in the surface illuminated by the laser, something completely unthinkable in laser eye surgery.

7. Moreover, Shei describes a method for spatially modulating the fluence in the surgical beam so as to cut a combination of a spherical and a cylindrical surface, i.e., an eye ball. In making inkjet nozzles, the primary consideration is to achieve uniformity of illumination, quite the contrary to the teachings of Shei.

8. Even if the teachings of Nishiwaki and Shei were to be combined, they would still not result in my invention. Nishiwaki describes a system for simultaneously manufacturing multiple inkjet nozzles. See the last two sentences of the abstract of Nishiwaki, for example, which read:

> the image of the row of openings is projected onto a plastic plate or the like so that a multiplicity of holes is formed in the plate. As a result, a nozzle plate of an ink jet printer head can be accurately and quickly manufactured.

9. In my invention, only a single aperture is formed, as specified in independent claims 9, 23, and 31 of the application. This runs counter to the intended 'quickly manufactured' advantage of Nishiwaki in that only one nozzle is formed at a time.

10. As noted above, Shei disclosed a method for energy delivery in laser eye surgery and produces only one beam. Modifying Nishiwaki by incorporating the method of Shei would eliminate or destroy the specific goal of Nishiwaki for simultaneously producing multiple beams to form multiple nozzles. Shei is limited to modulation of a single beam.

11. I, among others here at Xaar, have also found that the so-called 'accurate' nozzles achieved by the Nishiwaki method are in fact of lesser quality than those obtained by my invention. Although lower quality nozzles may be acceptable in the kind of disposable bubble-jet printhead made by Canon (the assignee of the Nishiwaki patent), we have found that they are less acceptable for the kind of product made by Xaar.

12. Similarly, nozzles made according to my invention (particularly independent claims 9, 23, and 31 of the application) have a nozzle inlet that is larger in diameter than the nozzle outlet, which again allows higher accuracy ejection of ink droplets and corresponding higher quality images than may be obtained using Nishiwaki.

13. The examiner has cited Turner for its teaching of such tapered nozzles and has stated that it would have been obvious to one having ordinary skill in the art at the time of my invention to modify both Nishiwaki and Shei further in view of Turner. According to the reasons I discuss below, an inkjet engineer would not look to combine Turner with both Nishiwaki and Shei. However, also as I discuss below, even if such a combination were made, the combination of Nishiwaki, Shei, and Turner would not result in my invention.

14. For an alternate rejection of the claims, the examiner has cited Turner in combination with Nishwaki, without further combining Shei. Turner is cited as evidence that rotation of a laser beam results in an inlet that is larger in diameter than the outlet produced. This generalization is not accurate. Referring to the figure on the front page of Turner, one will see that Turner employs a spherical lens and trepanning of a single beam to create the envelope of the reverse taper. The entire beam is moving (trepanning) around the axis 17, not just rotating about its own axis, to create the tapered hole.

15. In contrast, my invention uses a fixed beam width in an overall array which defines the envelope. Only the input beam to the 'flyeye' lens is rotated so as to produce time-averaged constant energy in all the beamlets issuing from the 'flyeye' lens. The outlet beam that forms the inkjet nozzle of my invention is not rotating. This is contrary to the teachings of Turner, wherein the entire beam impinging upon the aircraft skin 9 is still moving about the axis 17. If the teachings of Nishiwaki and Turner were to be combined, they would not result in my invention, regardless of whether the Shei teachings were also combined.

16. Also, if the Nishiwaki teachings were modified according to Turner, each of the multiple beams in Nishiwaki used to impinge upon a nozzle plate would be trepanning, not merely rotating about a beam axis. Alternatively, since Turner discloses only a single beam forming a single inlet and outlet for a hole in an aircraft wing, modifying Nishiwaki in accordance with Turner would again result in only forming one nozzle at a time, which would be wholly contrary to the specific multiple nozzle formation teachings of Nishiwaki.

17. The above comments regarding Turner ignore the fact that the reference also does not relate to formation of inkjet nozzles or to the field of inkjet generally. Instead, Turner relates to forming air flow nozzles in aircraft wings, a field completely unrelated to inkjet. Thus, it is my opinion that an inkjet engineer would not look to combine the teachings of Nishiwaki with those of Turner, regardless of whether the Shei teachings were also combined.

18. To summarize, my invention as defined in the independent claims incorporates features that are not obvious from a combination of either Nishiwaki, Shei, and Turner, or alternately, only Nishiwaki and Turner. Further, it is my opinion that an inkjet engineer would not look to the teachings of either Shei or Turner when considering modifications to the Nishiwaki inkjet nozzle formation teachings.

19. I hereby affirm that all of the foregoing statements are true and accurate to the best of my knowledge and belief, and that I am aware that any false statements may subject me to penalties for perjury and may jeopardize the validity of any patents that may issue on the present application.

October 14th, 2004

Stephen Temple
Inventor

RELATED PROCEEDINGS APPENDIX

None.